Instructor Resources

Custom Babies: The Ethical Dilemma of Genetic Editing

Project | Module 1: Unethical Biology

Created by:

Description

Gene-editing technology is a new and quickly developing tool that has important consequences in the field of biology and everyday life of individuals in society. In this lesson, students will first learn about CRISPR-Cas9 gene editing technology and then reflect in groups on the ethical implications of using this technology on human prenatal embryos through two example cases in order to get at cosmetic versus medical edits.

Suggested Courses

Biochemistry, Molecular Biology, Cell Biology, Developmental Biology, Genetics, Introductory Biology

Learning Goals

- Students will understand how CRISPR-Cas9 technology works as a gene-editing tool.
- Students will value the variety of perspectives on the ethics of prenatal human embryo gene-editing.

Learning Objectives

- Students will be able to describe how CRISPR-Cas9 technology edits genomes.
- Students will be able to evaluate the ethical basis of human prenatal medical and cosmetic gene-editing cases.
- Students will be able to discuss, collaborate and communicate the variety of perspectives on the ethics of genetic-editing using scientific and sociocultural history and reasoning.

Scientific Processing Skills:	Communication
Pedagogical Approaches:	Think-Pair-Share, Case Study, Collaborative Work, Reflective Writing
Bloom's Cognitive Levels:	Foundational: Factual Knowledge and comprehension, Analysis, Evaluation
Principles of how people learn:	Motivates student to learn material, focuses student on the material to be learned, requires students to do the bulk of the work
Vision and Change Competencies:	Ability to tap into the interdisciplinary nature of science, Ability to understand the relationship between science and society, Ability to communicate and collaborate with other disciplines
Core Biological Concepts Covered:	Structure and Function Information flow, exchange, and storage

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Additional Resources

Introductory Videos:

- https://www.youtube.com/watch?v=jAhjPd4uNFY
- https://www.youtube.com/watch?v=6tw_JVz_IEc
- https://www.youtube.com/watch?v=kFFyeHJDI50%E2%80%8B

CRISPR Technology

- https://www.aamc.org/news-insights/conversation-jennifer-doudna-phd-developer-crispr-gene-editing-technology
- https://www.businessinsider.com/how-crispr-will-revolutionize-biology-2015-10

CRISPR being developed and used in non-human organisms

- https://www.newscientist.com/article/2291194-tomato-is-first-crispr-edited-food-to-go-on-sale-in-the-world/

CRISPR being used in humans as treatments

- https://www.npr.org/sections/health-shots/2021/09/29/1040879179/vision-loss-crispr-treatment
- https://www.cancer.gov/news-events/cancer-currents-blog/2020/crispr-cancer-research-treatment
- https://www.npr.org/sections/health-shots/2021/06/26/1009817539/he-inherited-a-devastating-disease-a-crispr-gene-editing-breakthrough-stopped-it
- https://www.npr.org/sections/health-shots/2020/12/15/944184405/1st-patients-to-get-crispr-gene-editing-treatment-continue-to-thrive
- https://www.science.org/content/article/crispr-injected-blood-treats-genetic-disease-first-time

Designer baby: The idea of engineering a child with specific (usually more desirable) traits

- Edited Babies in China:
  - https://www.wsj.com/articles/how-a-chinese-scientist-broke-the-rules-to-create-the-first-gene-edited-babies-11557506697
  - https://www.nature.com/articles/d41586-019-00673-1
  - https://www.bbc.com/news/world-asia-china-50944461
  - https://www.science.org/content/article/crispr-bombshell-chinese-researcher-claims-have-created-gene-edited-twins
- Current Research:
  - https://www.nature.com/articles/d41586-020-01906-4
- Current Opinions/Perspectives:
  - http://content.time.com/time/magazine/article/0,9171,17696,00.html
  - https://embryo.asu.edu/pages/ethics-designer-babies
  - https://news.harvard.edu/gazette/story/2019/01/perspectives-on-gene-editing/

Debates/Next Steps

- https://www.nytimes.com/2021/07/12/science/gene-editing-crispr-who.html
- https://www.nature.com/articles/d41586-021-02625-0

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Adaptations

The following ideas are some possible adaptations:

- You can have students read material prior to class based on the emphasis you want to stress in class or develop a deeper background knowledge in: CRISPR technology, perspectives on gene editing, relevant sociocultural history or ethics.
- There are two longer videos that stress different aspects of the lesson that review more information. In addition to reviewing CRISPR these videos cover extra information:

1. Alternative Video 1: Unpacking the details and problem's in He's genetically edited twins scientific process
2. Alternative Video 2: History of science and desginer babies ethics

- You can adjust the group structure by changing groups after each case.

Implementation Guide

Activity	Description	Est Time	Notes
Pre-Reading (Optional)	Have students read articles related to CRISPR technology, genetic editing perspectives, or ethics prior to class	>1 hr	Choose articles with the theme/topic you want to emphasize
Introductory Lecture	Lecture with video explaning background information on CRISPR and genetic editing technology ethics.	10 min	Consider the alternative videos that cover additional information
Group Case Analysis	Students will be presented with multiple cases and analyze the perspectives and ethics	40 min	
Whole Class Discussion/ Wrap-Up	Groups will share major takeaways from their discussions	15 min	

Student Assessment

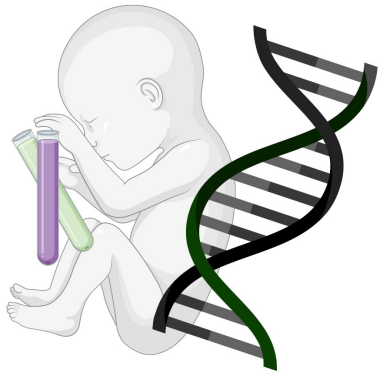
1. Describe the activity. What was the issue you learned about?
2. What did this activity teach you about the relationship between biology and society?
3. How did the activity illustrate how human values influence science?
4. What are the different perspectives presented as part of the activity today?
5. How do your personal values or experiences relate to the themes presented in this activity, if at all? Has the activity impacted your personal values or views?
6. Did the activity make you think differently about the issue than before today's activity? How?
7. How does the CRISPR-Cas9 enzyme edit the genome?
8. What are the pros and cons of using CRISPR-Cas9 technology to genetically edit humans?

Student Handout

Custom Babies: The Ethical Dilemma of Genetic Editing

Name: Date:

Custom Babies: The Ethical Dilemma of Genetic Editing



Introduction:

Since 2012, Jennifer Doudna has monumentally impacted the scientific community with her research of CRISPR-Cas9 as a possible tool that would revolutionize gene editing technology.

There have been numerous conversations about the ethics of using gene-editing technology in humans. Whether or not to experiment with somatic cell gene editing or gametic cell editing. Or prenatal gene editing versus postnatal gene editing. After scientist He Jiankui genetically edited three embryos that were born, the ethics of prenatal genetic editing has been particularly important to discuss in the scientific community and society at large.

In this lesson you will consider the variety of perspectives and societal impacts on prenatal genetic-editing technology.

Notes:

Student Handout

Custom Babies: The Ethical Dilemma of Genetic Editing

Name: Date:

Prenatal Gene Editing Cases

In this activity, you will be presented with two separate cases dealing with prenatal gene-editing. As a group, you will read through the cases, consider the different perspectives associated with each, and reflect on the ethical implications of each.

Case 1: Gene Editing HIV (read the full case here)
Grace and Mark desire to have a child together, however Mark is HIV positive. Mark never thought they'd be able to have children. Worried about the possibilities of their children contracting HIV, they consult their physician. They are notified of a research opportunity that uses gene-editing technology (CRISPR) to edit the *CCR5* gene (a protein that allows HIV to enter cells) so that the children could be protected from an HIV infection. This would be done through an in vitro fertilization process, a common procedure used for people seeking assistive reproductive technologies (such as same-sex couples, donors-single parents, folks struggling with infertility, etc). The sperm donor (Mark) and egg donor (Grace) would have their cells combined into an embryo and eventually transferred into a uterus.

- How does Grace and Mark's views of AIDS/HIV discrimination and stigma impact their decision on whether or not to use CRISPR gene-editing technology?

- In general, how could societal views of diseases, disorders, and disabilities impact science's ethical decision making in gene-editing?

- What factors should a researcher consider when contemplating using gene-editing technology for medical reasons?

- In this case and other cases where genetic-editing is used for medical reasons (prevention or treatment), is it ethical to allow prenatal gene-editing technology? Why or why not? Use both societal/cultural and scientific reasoning.

Student Handout

Custom Babies: The Ethical Dilemma of Genetic Editing

Name: Date:

Prenatal Gene Editing Cases

Case 2: Gene Editing Gender (read the full article here)

Maria and David are interested in having a child together but are struggling to conceive. They find that their insurance covers the very costly assisted-reproduction technology of in vitro fertilization. With multiple successful embryos, doctors screened the embryo's DNA using preimplantation genetic diagnosis (PGD) tests that are used to screen for any genetic differences or concerns. The fertility doctor returned asking whether or not they wanted to choose to incubate embryos that were a boy or a girl? Using CRISPR gene-editing technology would allow them to choose the eye color and other physical characteristics of their future children. After reflection, they decide to choose the embryo with the highest chance of a pregnancy success. The brown-eyed couple in the lobby next to them discloses their excitement of getting to select a boy with blue eyes.

- What factors led to Maria and David's decision? What factors might impact the decisions of the other couple in the lobby (for a baby boy with blue eyes)?

- In general, how could societal views of gender, race, sex, and other beauty standards impact science's ethical decision making in gene-editing?

- What factors should a researcher consider when contemplating using gene-editing technology for cosmetic reasons?

- In this case and other cases where genetic-editing is used for cosmetic reasons, is it ethical to allow prenatal gene-editing technology? Why or why not? Use both societal/cultural and scientific reasoning.

Student Handout

Custom Babies: The Ethical Dilemma of Genetic Editing

Name: Date:

Prenatal Gene Editing Cases

Concluding Thoughts

Capture your final thoughts and opinions in the space below. Consider the following questions as a group:

- In which cases, if any, should prenatal genetic editing technology be used? Why or why not? (Consider societal/cultural and scientific reasons)

- How does society impact genetic- editing science?

- How does genetic-editing science impact society?

Notes:

Student Assessment

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Name: Date:

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5. How do your personal values or experiences relate to the themes presented in this activity, if at all? Has the activity impacted your personal values or views?

6. Did the activity make you think differently about the issue than before today's activity? How?

7. How does the CRISPR-Cas9 enzyme edit the genome?

8. What are the pros and cons of using CRISPR-Cas9 technology to genetically edit humans?